UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

CARNEGIE INSTITUTION OF WASHINGTON and M7D CORPORATION,

Plaintiffs,

v.

PURE GROWN DIAMONDS, INC. and IIA TECHNOLOGIES PTE. LTD. d/b/a IIA TECHNOLOGIES,

Defendants.

Case No. 20-cv-189 (JSR)

LOCAL CIVIL RULE 56.1 STATEMENT OF MATERIAL FACTS IN SUPPORT OF DEFENDANTS PURE GROWN DIAMONDS, INC. AND IIA TECHNOLOGIES PTE. LTD.'S MOTION FOR SUMMARY JUDGMENT

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Pursuant to Local Civil Rule 56.1(a), Defendants Pure Grown Diamonds, Inc. ("PGD") and IIa Technologies Pte. Ltd. d/b/a/ IIa Technologies ("2AT") respectfully submit this Statement of Material Facts in support of their Motion for Summary Judgment.

I. THE '078 PATENT

1. U.S. Patent No. 6,858,078 ("the '078 Patent") issued on February 22, 2005, and claims priority to Provisional Application No. 60/331,073, filed on November 7, 2001. Ex. 1.[1] It is titled "Apparatus and Method for Diamond Production," and names Drs. Russell J. Hemley, Ho-kwang Mao, Chih-shiue Yan, and Yogesh Vohra as inventors.

2. Plaintiffs assert that Defendants infringe claims 1, 6, 11, 12, 16, and 20 of the '078 Patent. Ex. 2.

3. The asserted claims of the '078 Patent recite:

> **1.** A method for diamond production, comprising:
>
> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and
>
> growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface at a growth temperature in a deposition chamber having an atmosphere with a pressure of at least 130 torr.
>
> **6.** The method of claim 1, wherein the pressure is 130-400 torr.
>
> **11.** The method of claim 1, wherein a growth rate of the single-crystal diamond is 1 to 150 micrometer per hour.
>
> **12.** A method for diamond production, comprising:

[1] Exhibits 1 through 57 are attached to the accompanying Declaration of J. Preston Long.

> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and
>
> growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface at a temperature of 900–1400° C.
>
> **16.** The method of claim 12, wherein a pressure of an atmosphere in which diamond growth occurs is 130-400 torr.
>
> **20.** The method of claim 12, wherein a growth rate of the single-crystal diamond is 1 to 150 micrometer per hour.

Ex. 1 at 14:64–15:63.

4. Plaintiffs no longer assert claim 15 against Defendants. Ex. 2 at 3. Claim 15 depends on claim 12 and recites:

> **15**. The method of claim 12, wherein the atmosphere further includes 1-3% oxygen per unit of hydrogen.

Ex. 1 at 15:44-45.

5. When providing a Background of the Invention, the ’078 Patent acknowledges that growing diamond by MPCVD at lower temperatures and pressures was known, providing various examples of such processes and criticizing them. *Id*. at 1:15-59.

6. The ’078 Patent identifies a problem with respect to single-crystal diamond growth, stating that “[t]ypically, attempts to produce single-crystal diamond at growth rates higher than about one micrometer per hour result in heavily twinned single crystal diamonds, polycrystalline diamond, or no diamond at all.” *Id*. at 1:56-59.

7. The ’078 Patent then states that “Precise control over growth surface temperatures and growth surface temperature gradients prevents the formation of polycrystalline diamond or twins such that a large single crystal diamond can be grown.” *Id.* at 6:48-54; *see also id.* at 4:51-55, 5:1-10, 13:25-27, 13:66-14:1.

8. The ’078 Patent describes each of Figures 1, 3, and 5 as “a diagram of a diamond production apparatus according to [an] embodiment of the present invention in which a cross-section of deposition apparatus with a specimen holder assembly . . . is depicted.” *Id*. at 3:26-30, 3:31-40, 3:44-48.

9. Figures 1 through 5 of the ’078 Patent each depict aspects of a sample holder that makes thermal contact with the side surfaces of a growing diamond. *Id*. at 4:44-55, 5:34-47, 8:23-46, 9:30-37, 9:66-10:54, Figs. 1-5.

10. According to the ’078 Patent, the sample holder acts as a heat-sink to prevent the formation of twins or polycrystalline diamond along the edges of the growth surface of the diamond. *Id.* at 4:51-55, 5:31-34.

11. According to the ’078 Patent, the growth surface should extend 0 to 1.5 mm above the top of the sample holder. *Id.* at 5:1-10. By minimizing the electrical effect the substrate holder has on the plasma, higher reactor pressures (specifically, 130–400 torr) can be used. *Id.* at 9:48-65.

12. The ’078 Patent describes two processes for using these substrate holders and for how to position the diamond. *Id.* at 10:55-58, 11:12-31, 11:60-64, 12:6-46, Figs. 6, 7. In both, a pyrometer is used to measure a temperature gradient across the growth surface. *Id.* at 11:1-21, 12:6-20. If a temperature gradient less than 20° C. cannot be maintained, the growth process is halted, and the diamond is repositioned. *Id.* at 11:12-42, 12:21-46;

13. The ’078 Patent describes measuring temperature gradients during the growth process and using that information to adjust the process. *See* ’078 Patent at 2:12-25, 2:45-56, 6:65-7:46, 7:66-8:18, 9:66-10:20, 11:1-59, 12:6-13:3; Figs. 6, 7.

14. The ’078 Patent states that “[t]he ability to control all of the temperature gradients across the growth surface of the diamond 136 is influenced by several factors,” including:

> the heat sinking capability of the stage 124, the positioning of the top surface of the diamond in the plasma 141, the uniformity of the plasma 141 that the growth surface of the diamond is subjected to, the quality of thermal transfer from edges of the diamond via the holder or sheath 134 to the stage 124, the controllability of the microwave power, coolant flow rate, coolant temperature, gas flow rates, reactant flow rate and the detection capabilities of the infrared pyrometer 142.

Id. at 6:55-65.

15. The ’078 Patent states that growth usually continues as long as the diamond “is smooth in nature, without isolated ‘outcroppings’ or twins.” *Id.* at 13:4-10. It further states that this condition “may be verified visually.” *Id.*

16. According to the ’078 Patent, the process temperature can be selected from 900–1400° C., depending on whether oxygen is used. *Id.* at 13:22-24.

17. The ’078 patent provides the table below to show the results of different temperatures without the use of oxygen. *Id.* at 14:8-28, tbl. 1.

TABLE 1

Process temperatures for various types of diamond

Temperature Range	Type of Diamond Produced
<1000° C.	Spherical, black diamond-like carbon (DLC)
1000–1100° C.	Smooth dark brown
1100–1200° C.	Brown
1200–1220° C.	Smooth, yellow tint growth
1220–1400° C.	Step-flow type with pyramid like octahedra tinted yellow
>1300° C.	Twinned or polycrystalline diamond

18. The ’078 Patent teaches using a pressure of about 130-400 torr. *Id.* at 13:27-29.

19. The ’078 Patent provides two examples of diamonds grown according to the described methods. *Id.* at 13:38-14:39. In Example 1, the pressure was 160 torr, the temperature was 1220° C., the methane concentration was 12% (CH_4/H_2), and the nitrogen concentration was 3% (N_2/CH_4). *Id.* at 13:51-55. The resulting diamond grew to a thickness of 0.7 mm. *Id.* at 13:57-59. It had only “a small degree of polycrystallinity localized at the top edges.” *Id.* at 13:66-14:1. Example 2 was grown to 0.6 mm thick using the same conditions as Example 1, except 1–3% oxygen was added, and the temperature was 900° C. *Id.* at 14:30-34. According to the ’078 Patent, the additional oxygen allows a lower growth temperature. *Id.* at 14:34-37.

20. To provide “[a]dditional information with regard to the diamond produced in the examples described above,” the ’078 Patent expressly incorporates by reference “Very High Growth Rate Chemical Vapor Deposition of Single-Crystal Diamond' Proceedings of the National Academy of the Sciences, Oct. 1, 2002, volume 99, no. 20., pages 12523-12525,” (hereinafter “*Yan-3*”) a scientific paper by the inventors. *Id.* at 14:43-49 (citing Ex. 3).

21. *Yan-3* describes a diamond grown using a pressure of 160 torr, a temperature of 1220° C., a methane concentration of 12% (CH_4/H_2), and a nitrogen concentration of 3% (N_2/CH_4). Ex. 3 at 1-2. The resulting diamond was 0.7 mm thick. *Id.* at 2. It had only “a small degree of polycrystallinity or twinning” that was “localized on the edge.” *Id.* A picture of that diamond appears below.

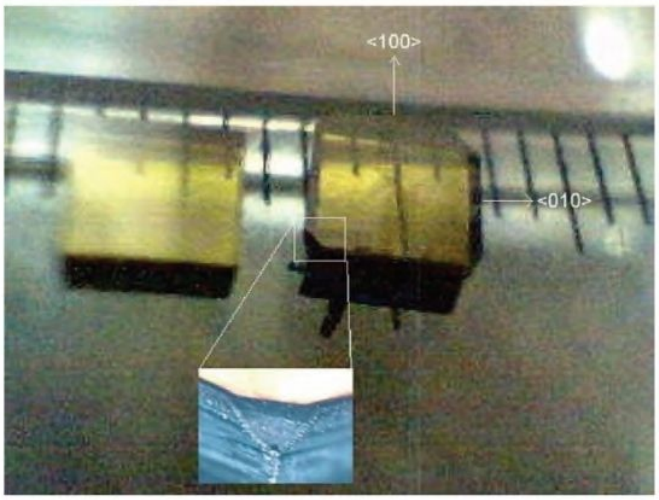


Fig. 1. Photograph of seed and as-grown unpolished CVD diamond and a magnification of CVD-diamond corner. The ⟨100⟩ direction corresponds to the four sides of the diamond cube.

Ex. 3 at Fig. 1

22. [redacted]

23. *Yan-3* states that "the growth morphology and color strongly depend on temperature," and teaches that "spherical black diamond-like carbon was produced below 1,000° C . . . ." Ex. 3 at 1.

II. THE 078 PATENT IS NOT INFRINGED AND IS INVALID

A. THE ASSERTED 078 PATENT CLAIMS ARE NOT INFRINGED

1. Defendants do not infringe the '078 Patent, literally or under the doctrine of equivalents

a. Defendants and Development of 2AT's Accused Process

24. 2AT is the only Defendant that grows diamonds. Ex. 5 at 38:11-39:14; Ex. 6 at 49:2-9, 53:14-54:1, 76:10-18.

25. 2AT grows diamonds outside the United States, in Singapore. Ex. 5 at 38:11-39:14.

26. [redacted]

27. [redacted]

28. [redacted]

29. Around 2008, 2AT tried to improve the color of 2AT's diamonds using diborane gas. *Id.* at 18:19-20:2. This work was also patented. *Id.* [redacted]

30. [redacted]

31. [redacted]

32. [redacted].[2]

[2] These records are voluminous but can be made available at the Court's request. They are collected in Exhibit 117 to the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

b. Description of 2AT's Accused Process

33. [redacted]

34. [redacted]

35. [redacted]

Ex. 8; *see also generally* Ex. 9; Ex. 10 at ¶ 153.

36. Dr. Misra testified [redacted]

37. [redacted]

[redacted]

Carnegie_189_2AT-00144991

38. [redacted]

[redacted]

39. [redacted]

[redacted]

40. [redacted]

41. [redacted]

[redacted]

42. [redacted]

[redacted]

[redacted]

43. [redacted]

[redacted]

[redacted]

44. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

45. [redacted]

[redacted]

46. [redacted]

[redacted]

47. [redacted]

48. [redacted]

[redacted]

49. [redacted]

[redacted]

50. [redacted]

[redacted]

51. [redacted]

[redacted]

52. [redacted]

53. Dr. Vohra explained that adjusting the microwave power controls temperature, not temperature gradients. Ex. 18 at 162:6-163:1, 179:23-180:9, 211:17-213:19.

54. Adjusting the power of a plasma source to control temperature during diamond growth was known before the application for the '078 Patent was filed. *See* Ex. 19 at 6:6-17; Ex. 20 at 1:63-67.

55. [redacted]

56. [redacted]

57. [redacted]

[3] 2AT produced images of several dozen similar examples that can be made available at the Court's request. They are collected in Exhibit 79 of the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

[redacted]

58. [redacted]

[redacted][4] [redacted]

59. [redacted]

[redacted]

c. 2AT's Process Data

60. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[4] 2AT produced images of several dozen similar examples that can be made available at the Court's request. They are collected in Exhibit 80 of the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

[5] [redacted] are voluminous but can be made available at the Court's request. PDF versions of the reports are located at Carnegie_189_2AT-00144859 through 144982; Carnegie_189_2AT-00145040 through 145194; Carnegie_189_2AT-00145256 through 145530;

[redacted]

Carnegie_189_2AT-00145585 through 145741; Carnegie_189_2AT-00145780 through 145904; and Carnegie_189_2AT-00145907 through 145927.

[6] [redacted] are voluminous but can be made available at the Court's request. PDF versions of the reports are located at Carnegie_189_2AT-00000577 through 56564. Excel spreadsheets containing the data from the Growth Logs are located at Exhibits 105 through 110 of the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

[7] [redacted] are voluminous but can be made available at the Court's request. PDF versions of the reports are located at Carnegie_189_2AT-00056565 through 104356. Excel spreadsheets containing the data from the Growth Logs are located at Exhibits 111 through 116 of the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

[redacted]

62. [redacted]

63. After examining the [redacted] information provided by 2AT, Defendants' expert Dr. Nebel found [redacted]

64. [redacted].

65. Defendants' expert Dr. Nebel analyzed the [redacted]. Ex. 12 at ¶ 533. He also examined the [redacted] and testimony from 2AT's witnesses. *See id.* Dr. Nebel found that the data confirms the [redacted] and testimony. *Id.* Dr. Nebel

prepared the chart below to visually summarize [redacted]

[redacted] *Id.*

[redacted]

66. [redacted]

[redacted]

67. Plaintiff M7D's CTO Yarden Tsach testified

d. 2AT's Rough Diamond Blocks

68. Plaintiffs' expert Dr. Capano acknowledges

69. Dr. Yogesh Vohra, one of the inventors named on the '078 Patent, testified that "in this field, even if you know there is one twin, then it's not a single crystal." Ex. 18 at 81:7-11.

70. Dr. Vohra testified that if there are black spots on the surface, "[t]hat's definitely twinning" and "definitely not single crystal." *Id.* at 82:3-17. "Visually, you can tell." *Id.*

71. The '078 Patent states that "isolated 'outcroppings' or twins . . . may be verified visually." Ex. 1 at 13:4-16.

72. The photograph below shows a physical rough diamond block that has been produced in this matter. Ex. 25. [redacted]

73. Dr. Capano does not opine on the [redacted] *See id.* at ¶ 239.

74. Dr. Capano opines [redacted]

[redacted]

75. Dr. Capano's report states [redacted]

[redacted]

76. [redacted]

[redacted]

77. 2AT's technical manager, Mr. Ghosh, testified [redacted]

[redacted]

He testified that:

[redacted]

[8] 2AT produced images of several dozen similar examples that can be made available at the Court's request. They are collected in Exhibit 82 of the Rebuttal Expert Report of Dr. Nebel Regarding Non-Infringement of the '078 Patent.

[redacted]

78. A plasma can couple more strongly to the edges of a growing diamond, sometimes called the "edge effect," which can cause a "temperature rise at the edges and corners" such that "dislocations, twins and other defects are more likely to occur." Ex. 26 at 3-5; Ex. 27 at 8; Ex. 28 at 201:22–202:14.

e. Dr. Capano's Experiments

79. Plaintiffs' expert Dr. Capano performed [redacted]

80. [redacted]

81. [redacted]

82. [redacted]

83. A footnote in Dr. Capano's report states [redacted]

84. [redacted]

f. Dr. Capano's Computer Model

85. [redacted]

g. Dr. Capano's Opinions [redacted]

91. Dr. Capano opines that [redacted]

[redacted]

92. Dr. Capano opines that [redacted]

93. Dr. Capano opines [redacted]

2. Defendant's extraterritorial conduct does not infringe the '078 Patent

a. Plaintiffs' Contentions

94. Plaintiffs contend that Defendants directly infringe the '078 Patent under 35 U.S.C. §§ 271(a) and (g). Ex. 2 at 3.

95. Plaintiffs contend that Defendants indirectly infringe the '078 Patent under 35 U.S.C. §§ 271(b) and (c). *Id.*

96. Plaintiffs contend that 2AT reduces its CVD grown diamonds' impurities and structural defects by a subsequent annealing process. Ex. 10 at ¶¶ 109.

97. Dr. Capano, in his expert report, [redacted]

B. THE ASSERTED 078 PATENT CLAIMS ARE INVALID

1. All the asserted '078 Patent claims are invalid under 35 U.S.C. § 112 for lack of enablement and written description

98. M7D's documents describe [redacted]

99. M7D's documents state [redacted]

100. M7D's documents state [redacted]

101. M7D's documents state, [redacted]

102. Dr. Yogesh K. Vohra, a named inventor of the '078 Patent, testified that one of the key innovations of the '078 Patent was control of thermal gradients "by a proper heat sink design of the substrate hold[er]." Ex. 18 at 162:6-163:1; *see also id.* at 211:24-213:19.

103. Dr. Vohra testified that uniformity of temperature on the growth surface "really depends on the substrate holder design, which is critical in controlling the uniformity of temperature." *Id.* at 129:1-19; *see also id.* at 129:8-19, 153:16-22, 154:11-18, 179:23-180:9, 189:12-190:6.

104. Dr. Vohra testified that the temperature of the growth surface is not the same as the temperature gradients on the growth surface. *See id.* at 211:23-212:24.

105. Dr. Vohra testified that temperature and temperature gradient are controlled by different techniques: Temperature is controlled by adjusting the microwave power or the distance of the diamond relative to the plasma, *id.* at 213:5-10, whereas temperature gradients, are controlled by using a substrate holder that provides heat-sinking to the side surfaces of the diamond. *Id.* at 162:6-163:1, 179:23-180:9, 213:11-19

106. The other three named inventors of the '078 Patent—Drs. Russell J. Hemley, Ho-Kwang Mao, and Chih-shiue Yan—authored an article stating that "[o]ne of the critical issues in diamond synthesis employing an MPCVD reactor is the behavior of plasma-substrate and plasma-substrate holder interactions." Ex. 30 at 3.

107. Dr. Vohra testified that "it's really a complicated, complicated thing to consider what effect different [MPCVD process] parameters have." Ex. 18 at 42:5-20. He further testified that "it's really a multiparameter space . . . changing one parameter can give you [a] new answer." *Id.* at 56:1-22; *see also id.* at 214:2-21. He agreed that "if you change one thing in the system, it might affect other things." *Id.* at 47:4-18.

108. When asked how density of the microwave plasma affect the growth rate, Dr. Vohra testified that "I would hesitate to make a generalized statement because it's so design specific." *Id.* at 46:20-47:3.

109. One of Dr. Vohra's students remarked in a 2009 dissertation that "[a]ny small variation in growth conditions can lead to huge changes in the behavior of growth radicals in the plasma and near the substrate surface and it is nearly impossible to account for all possible changes in a theoretical explanation." Ex. 31 at 53; Ex. 18 at 214:2-21.

110. More than a decade after the '078 Patent filing date, inventor Hemley acknowledged that "[t]he details [of CVD diamond growth] are still not completely understood." Ex. 32.

111. Carnegie and the University of Alabama (UAB) previously shared ownership the '078 Patent. Ex. 33; Ex. 49.

112. [redacted]

113. A representative from UAB stated in an email to Carnegie [redacted]

114. With respect to [redacted] M7D's process, Yarden Tsach, M7D's Chief Technical Officer and corporate representative on technical matters, testified [redacted]

115. [redacted]

2. Claims 12, 16, and 20 of '078 patent are invalid for lack of written description because the inventors did not possess the full scope of claims as written

116. Dr. Vohra, one of the named inventors of the '078 Patent, confirmed during his deposition that "below a 1000 degrees C without oxygen, [he] grew spherical black diamond-like carbon" and that it was the addition of oxygen that allowed him to reduce the growth temperature to grow diamond. Ex. 18 at 126:20-25.

117. When asked about Table 1 in the '078 Patent, Mr. Tsach, M7D's CTO and corporate representative on technical matters, testified, [redacted]

[redacted]

III. THE '189 PATENT

118. U.S. Reissue Patent RE41,189 ("the '189 Patent") issued on April 6, 2010, and reissued from U.S. Patent No. 6,811,610 ("the '610 Patent"). Ex. 39. The '189 Patent is titled "Method of Making Enhanced CVD Diamond," and names Drs. Wei Li, Russell J. Hemley, Ho-kwang Mao, and Chih-shiue Yan as inventors. U.S. Application No. 10/161,266, which issued as the '610 Patent, was filed on June 3, 2002. *Id.*

119. Plaintiffs assert that 2AT's annealing process infringes claims 1 and 2 of the '189 Patent. Ex. 2 at 3; Ex. 10 at ¶¶ 365-66.

120. The asserted claims of the '189 Patent recite;

> **1.** A method to improve the optical clarity of CVD diamond where the CVD diamond is single crystal CVD diamond, by raising the CVD diamond to a set temperature of at least 1500° C. and a pressure of at least 4.0 GPA outside of the diamond stable phase.
>
> **2.** The method of claim 1 wherein the CVD diamond is a single crystal coating upon another material.

Ex. 39 at 4:10-16.

121. Plaintiffs specifically contend that 2AT's annealing process improves the optical clarity of the annealed diamond as recited in the preamble limitation of claim 1 of the '189 patent. Ex. 2 at 3; Ex. 10 at ¶ 367.

122. The '189 Patent states:

> It would be advantageous if a method were devised that would significantly improve the properties of CVD diamond after it is grown. It would also be desirable to form CVD diamond with fewer defects that serve to degrade the intrinsic properties of a perfect

> crystalline diamond material in order to enhance its usage in many applications.

Id. at 1:44-49.

123. The '189 patent states that "treating CVD diamond at high pressure and high temperature (HPHT) causes the optical properties to change so much that opaque material become clear." *Id.* at 2:29-32.

124. The '189 Patent states:

> Possibly, internal atoms shift position to more correctly align themselves to the diamond crystalline structure or perhaps the bonding mechanism shifts such that SP2 type bonds become SP^3 type bonds causing carbon atoms to change from impurity status to becoming part of the diamond crystal lattice.

Id. at 2:23-28.

125. The '189 Patent states:

> It would be advantageous if a method were devised that would significantly improve the properties of CVD diamond after it is grown. It would also be desirable to form CVD diamond with fewer defects that serve to degrade the intrinsic properties of a perfect crystalline diamond material in order to enhance its usage in many applications.

Ex. 39 at 1:44-49.

126. High Pressure/High Temperature ("HPHT") annealing can alter a diamond's atomic and chemical structure and its physical properties. [redacted]; *see* Ex. 1 at 14:40-42; Ex. 39 at 2:23-32; [redacted]; [redacted], [redacted]; Ex. 43 at 1:25-32, 1:51-53, 4:4-13, 7:51-57; Ex. 44 at 1193; Ex. 45 at 189; Ex. 46 at 42.

127. Dr. Frushour, one of the named inventors on the patent that reissued as the '189 Patent, testified [redacted]

[redacted]

128. Defendants' expert Dr. De Weerdt provided an opinion that scientific literature supports a finding that annealing significantly changes a diamonds' atomic structure and physical properties. *See* Ex. 40 at ¶¶ 82-84.

The report of Plaintiffs' expert Dr. Capano [redacted]

129. Claims 1 and 2 of the '189 Patent do not provide a definition for the diamond-graphite boundary. Ex. 39 at claims 1 and 2.

130. The specification of the '189 Patent does not provide a definition for the diamond-graphite boundary. Ex. 39.

131. The specification of the '189 Patent mentions operating "where graphite is the stable phase" and "within the graphite stable region." *Id.* at 2:41-50. Specifically, the '189 Patent states:

> Thus, one would expect that when diamond is heated to temperatures above 850° C., at pressures where graphite is the stable phase, significant degradation of the sample would result. However, very unexpected behavior occurs in CVD diamond at high temperatures where the pressure is raised above atmospheric pressure but still remains within the graphite stable region. Under certain conditions of temperature and pressure, CVD diamond does not degrade; instead the opposite occurs: the sample is transformed into a more perfect diamond crystalline material.

Id. at 2:41-50.

132. The Applicant's remarks during the prosecution history of the '189 Patent do not provide a definition for the diamond-graphite boundary. *See generally* Ex. 47.

133. As of June 3, 2002, at least the following four references provided different definitions for the diamond-graphite boundary:

Reference
Ex. 49, F.P. Bundy et al., *The Pressure-Temperature Phase and Transformation Diagram for Carbon*; Updated Through 1994, 34 CARBON 141, 142 (1996) ("*Bundy*")
Ex. 50, U.S. Patent No. 4,124,690 (1978) at Fig. 1 ("*Strong*")
Ex. 51, C.S. Kennedy & G.C. Kennedy, *The Equilibrium Boundary Between Graphite and Diamond*, 81 JOURNAL OF GEOPHYSICAL RESEARCH 2467, 2467 (1976) ("*Kennedy & Kennedy*")
Ex. 52, R. Berman & Sir F. Simon, *On the Graphite – Diamond Equilibrium*, 59 Zeitschrift für Elektrochemie, Berichte der Bunsengesellschaft für physikalische Chemie 333, 338 (1955) ("*Berman & Simon*")

Ex. 10 at ¶ 382.

134. Plaintiffs' corporate witnesses, inventor Russell J. Hemley, and Plaintiffs' technical expert Dr. Capano all acknowledge [redacted]

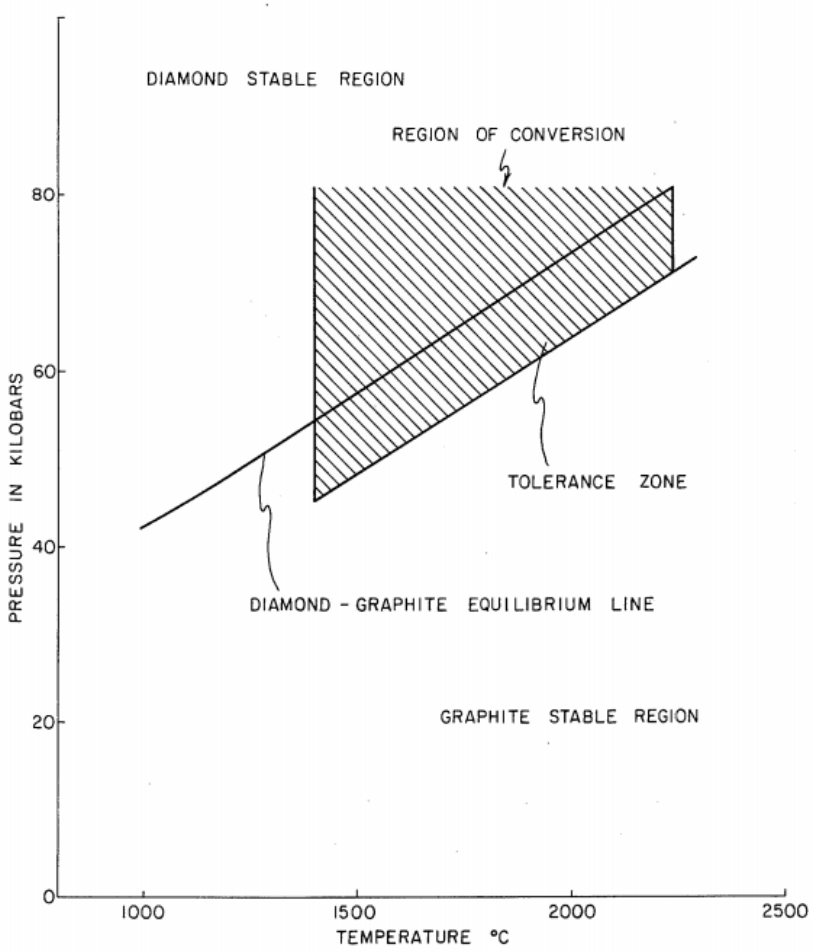
135. *Bundy* provides a definition for the diamond-graphite boundary as follows:

> The topology of stability fields of the thermodynamically stable phases is quite simple: (i) the boundary between the graphite and diamond stable regions which runs from 1.7 GPa/0 K, to the graphite/diamond/liquid triple point at about 12 GPa/5000K . . . .

Ex. 49 at 2; *see also* Ex. 4 at 168:3-23.

136. Two of the co-authors of *Bundy*, Drs. Russell J. Hemley and Ho-kwang Mao, are named as inventors of the '189 Patent. *See* Ex. 49 at 141; Ex. 39.

137. *Strong* provides a graphical plot of the diamond-graphite boundary as shown in the figure below:



Ex. 50 at Fig. 1.

138. *Kennedy & Kennedy* provides a definition for the diamond-graphite boundary as follows:

> Our newly determined boundary has the equation P(kbar) = 19.4 + T (°C)/40 kbar.

Ex. 51 at 2467.

139. *Berman & Simon* provides a definition for the diamond-graphite boundary as follows:

> It may be useful to give an equation for the equilibrium pressure above 12000 ° K. This is: –
>
> $P_{ats} = 7000 + 27T$ (°K) $\quad T > 1200$ °K

Ex. 52 at 338.

IV. THE 189 PATENT IS INVALID OR ALTERNATIVELY, NOT INFRINGED

A. THE ASSERTED '189 PATENT CLAIMS ARE INVALID AS INDEFINITE

140. Howard W. Day, *A Revised Diamond-Graphite Transition Curve*, 97 AMERICAN MINERALOGIST 52-62 (2012) ("*Day*") published in 2012. Ex. 54.

141. Dr. Capano provides an opinion that [redacted]

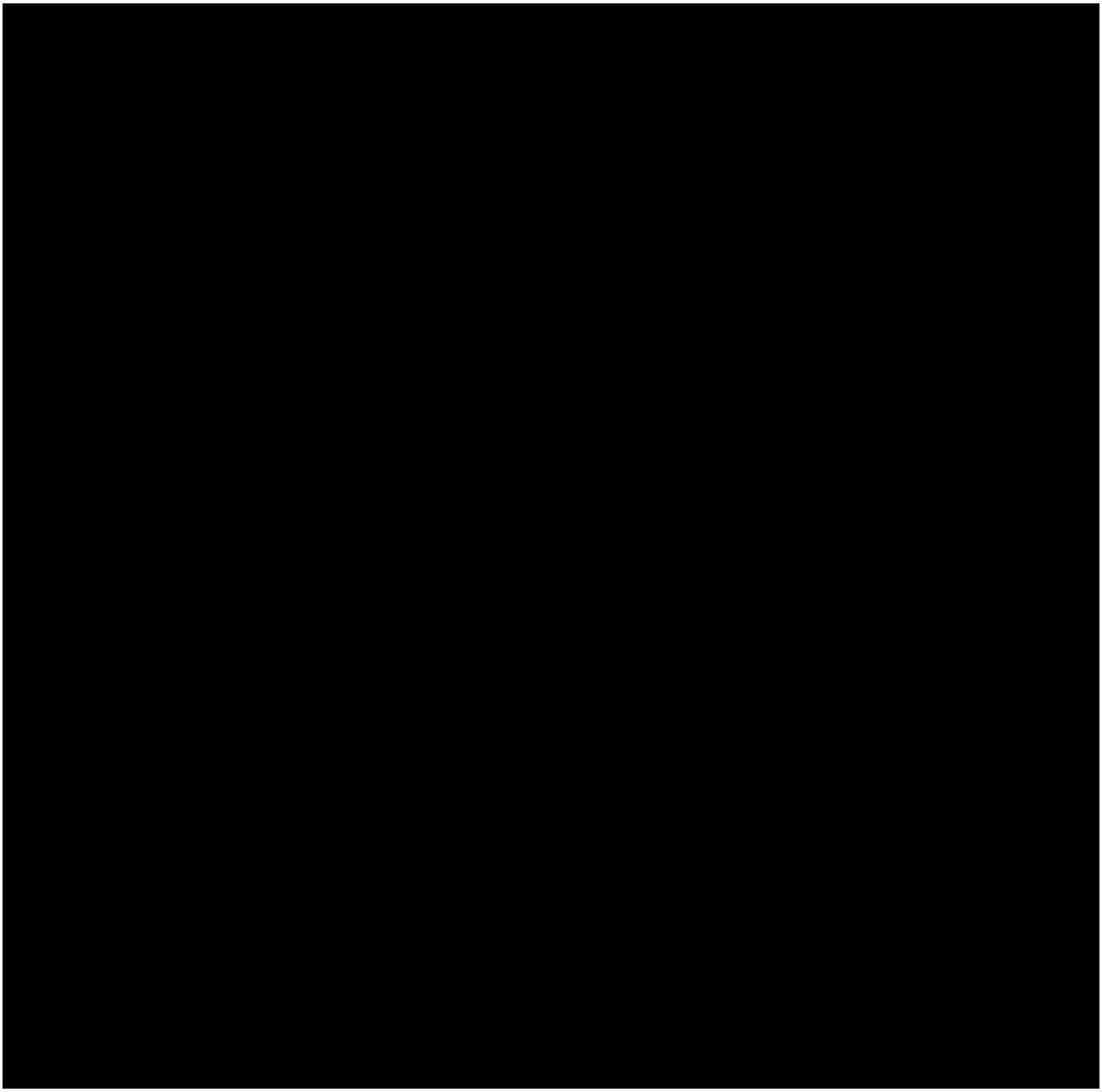
142. *Day* provides a definition for the "G&K corrected line" as follows:

> The corrected experiments are approximately described by the equation (Table 1)
>
> $$P \text{ (kbar)} = 16.5 + 0.027T_{GK} \text{ (°C)}$$

Ex. 54 at 54.

143. Dr. Capano [redacted]

Dr. Capano provides the illustration below and states:



144. Dr. Capano recognizes [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

B. THE ASSERTED '189 PATENT CLAIMS ARE NOT INFRINGED

145. [redacted] Ex. 40 at ¶¶ 89-93.

146. [redacted]

147. [redacted]

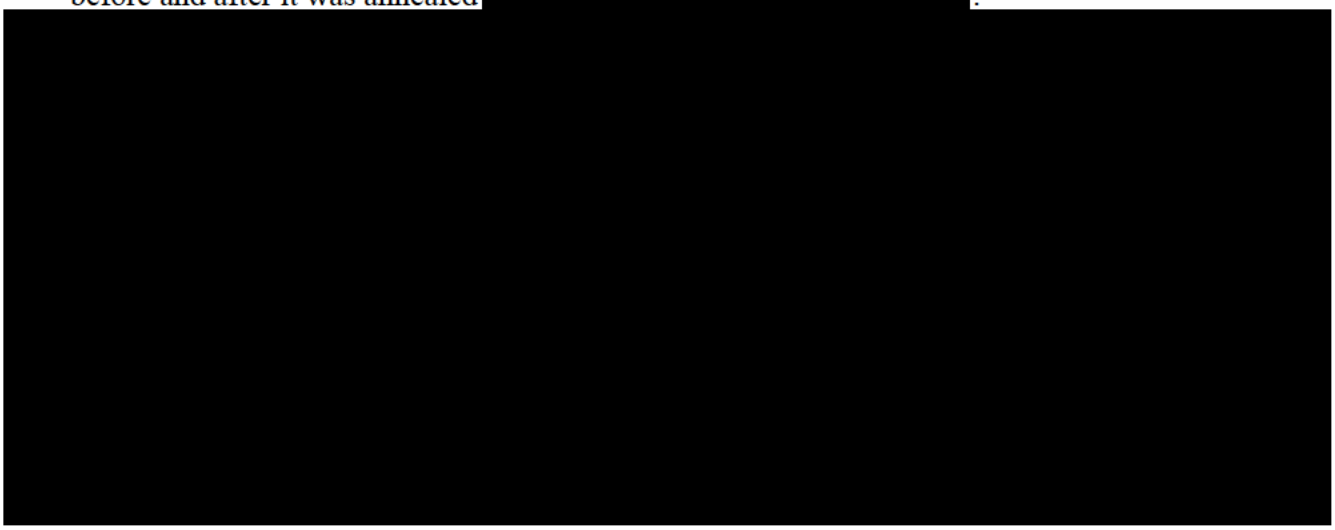
148. Defendants' expert Dr. De Weerdt analyzed [redacted]. Ex. 57 at ¶¶ 64-79. He also examined the testimony of 2AT's witnesses. *Id.* at ¶¶ 38-57, 69-70. Dr. De Weerdt found the data and testimony to be consistent. *Id.* at ¶ 59. Dr. De Weerdt prepared the chart below to visually summarize [redacted]. *Id.* at ¶ 72-73.

[9] These [redacted] are voluminous but can be made available at the Court's request. PDF versions of the reports are located at Carnegie_189_2AT-00126324-6917; Carnegie_189_2AT-00122022-3129; Carnegie_189_2AT-00124071-5432; Carnegie_189_2AT-00125433-6323; Carnegie_189_2AT-00123130-4070; Carnegie_189_2AT-00121903-2021. An Excel spreadsheet containing the data [redacted] is located at Exhibit 10 of the Rebuttal Expert Report of Dr. De Weerdt Regarding the Non-Infringement of Claims 1 and 2 of U.S. Patent No. RE41,189.

[10] [redacted]. This spreadsheet can be made available at the Court's request and is located at Carnegie_189_2AT_00126992.

149. Color and clarity are two of the "4 Cs" that drive consumer purchases of jewelry. Ex. 10 at ¶¶ 110-20, 351.

150. The following images show an example of the color and clarity of a diamond before and after it was annealed :



151. .

152. [redacted]

[redacted]:

[redacted]

153. Dr. Hemley testified that when it was published, *Bundy* "present[ed] the entire phase diagram as we currently understand it." Ex. 4 at 166:2-168:2; Ex. 49 at 1. Dr. Hemley stated as follows:

> **Q.** It says, "The plan for this article is to present the entire phase diagram as we currently understand it and then discuss each part giving the salient references and brief descriptions of the work upon which it is based." Do you see that?
>
> **A.** Yes.
>
> **Q.** Is that what this article does?
>
> **A.** Mm-hmm.
>
> * * *
>
> **Q.** And in the text here on the same page under "The Phase and Reaction Diagram," it says, "The topology of stability fields of the thermodynamically stable phases is quite simple: (i) the boundary between the graphite and diamond stable regions which runs from 1.7 GPa/0 K, to the graphite/diamond/liquid triple point at about 12GPa/5000K." Is that referring to this line here?
>
> **A.** Yes.
>
> **Q.** Between 5,000 and zero?
>
> **A.** Yes, yes.
>
> **Q.** Is that the transition between the diamond and graphite stable regions of the phase diagram?
>
> **A.** That defines the thermodynamic boundary between graphite and diamond.

Ex. 4 at 167:19-168:24.

154. [redacted]

155. [redacted]

156. In his deposition in a Singapore litigation, 2AT's representative, Mr. Vishal Mehta, was asked about the following illustration:

Ex. 55 at ¶ 231.

157. The dotted line in the illustration above corresponds to the *Bundy* definition of the diamond-graphite equilibrium line, not the *Berman & Simon* definition. Ex. 57 at ¶ 70.

158. Mr. Mehta testified about the illustration as follows:

[redacted]

[redacted]

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Respectfully submitted,

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